DOCUMENT RESUME

ED 342 615 SE 052 010

TITLE Science, Technology and Outreach Courses by Distance Education. Regional Co-Operative Programme in Higher Education for Development in Asia and the Pacific. A Workshop-Report.

INSTITUTION United Nations Educational, Scientific, and Cultural Organization, Bangkok (Thailand). Regional Office for Education in Asia and the Pacific.

PUB DATE 89

NOTE 74p.

PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.

DESCRIPTORS Disadvantaged; *Distance Education; Foreign Countries; Higher Education; *Open Universities; *Outreach Programs; *Science and Society; *Technology; Workshops

ABSTRACT

This report is the outcome of a regional workshop on development of science, technology and outreach courses held at Sri Lanka Foundation Institute in Colombo. The workshop emanated from UNESCO's commitment and continued effort to promote cooperation among the distance teaching universities in the region through the sharing of their experience and expertise. Distance education and open university systems are emerging as a major means of broadening access to higher education particularly among the disadvantaged groups. The workshop sought to identify common issues, problems and trends associated with the development and implementation of science, technology and outreach programs and courses by distance education. Chapters include: (1) "Issues, Problems and Trends in the Development of Science, Technology and Outreach Programs and Courses"; (2) "Approaches to the Development of Science, Technology and Outreach Programs by Distance Education"; (3) "Policy Alternatives and Measures for Augmentation of Science, Technology and Outreach Courses"; (4) "Cooperation among Institutions"; and (5) "Summary and Conclusions". A list of workshop participants and a summary of the present status of science, technology and outreach programs and courses in participating institutions are appended. (KR)

Unesco. Principal Regional Office for Asia and the Pacific.
Science, technology and outreach courses by distance education; a workshop report. Bangkok, Unesco. 1989.
67 p. (Regional Co-operation Programme in Higher Education for Development in Asia and the Pacific)

1. SCIENCE AND TECHNOLOGY – DISTANCE EDUCATION – ASIA/PACIFIC. 2. DISTANCE EDUCATION – ASIA/PACIFIC. 3. HIGHER EDUCATION – ASIA/PACIFIC. I. Title. II. Series.

378.5

Regional Co-operative Programme in Higher Education
for Development in Asia and the Pacific

SCIENCE, TECHNOLOGY AND OUTREACH COURSES BY DISTANCE EDUCATION

A Workshop-Report

UNESCO PRINCIPAL REGIONAL OFFICE
FOR ASIA AND THE PACIFIC

Bangkok, 1989

Published by the
Unesco Principal Regional Office for Asia and the Pacific
P.O. Box 967, Prakanong Post Office
Bangkok 10110, Thailand

Printed in Thailand

The designations employed and the presentation of material throughout the publication do not imply the expression of any opinion whatsoever on the part of Unesco concerning the legal status of any country, territory, city or area or its authorities, or concerning its frontiers of boundaries.

IM/267-500

Table of Contents

PREFACE

This report is the outcome of a regional workshop on development of science, technology and outreach courses held at Sri Lanka Foundation Institute, Colombo from 19 to 23 September 1988. The Workshop was organized jointly by Unesco Principal Regional Office for Asia and the Pacific and the Open University of Sri Lanka under UNDP funded Project RAS/86/171 - Regional Technical Co-operation in Higher Education. Nine senior academics from eight countries, six observers from the host country and a staff member of UNESCO participated in the Workshop. (List of participants is at Appendix B.)

The Workshop emanated from UNESCO's commitment and continued effort to promote co-operation among the distance teaching universities in this region through the sharing of their experience and expertise. To that objective, a series of regional and national training activities on various aspects of distance and open education had been organized over the years The present workshop was one that had been identified during such activities and addressed itself to the specific issues related to science, technology and outreach programmes and courses.

Distance education and open university systems are emerging as a major means of broadening access to higher education particularly among the disadvantaged groups. They have proved to be cost effective in improving educational opportunities. It has also been demonstrated that it is possible to teach science and technology

courses effectively through the distance teaching mode. The rapid development of communication technology should facilitate further development in distance education.

The purpose of distance education at tertiary level is not only to provide an opportunity for people to complete degree or diploma programmes. It also provides an important means of acquiring new knowledge as a part of continuing education. While courses have been developed in a number of discipline areas, need for such courses is still great in science and technology. The teaching of science and technology courses involving practical work, by distance education, requires special techniques and materials. While such aids have been developed, special orientation of administrative and academic staff is required to conduct these programmes.

Distance education and open university system particularly lend themselves to the running of short programmes. This involves extension work and continuing education to benefit the community. Training in the management and methodology for the conduct of extension courses at different levels and designed for different target groups is essential.

The workshop in particular analysed the present status of science, technology and outreach programmes in the participating institutions and discussed strategy and methodology for the development of such courses. The workshop also discussed policy and measures needed to augment science, technology and outreach courses and suggested ways and means for increased co-operation among the participating institutions in promoting such courses.

Chapter One

ISSUES, PROBLEMS AND TRENDS IN THE DEVELOPMENT OF SCIENCE, TECHNOLOGY AND OUTREACH PROGRAMMES AND COURSES

The workshop sought to identify common issues, problems and trends associated with the development and implementation of science, technology and outreach programmes and courses by distance education. Despite the wide variations in the environments in which the institutions operated and differences in the range and level of courses that were offered, the workshop participants were able to define a number of shared concerns. These general aspects of programme development and implementation are presented in this section of the report.

It should be noted that the range of issues of common concern identified by the workshop participants was quite large. However, many of the issues were characteristic of distance education in general and were not peculiar to courses or programmes in science and technology. Only those issues that have a significant impact upon the development and implementation of courses or programmes in science and technology have been noted in this section. For convenience the issues are considered under six headings. (Reports of participating institutions are presented in Appendix A.)

Practical Work

Practical work is a major component of most courses in science and technology. In this regard programmes in science and

technology differ markedly from other distance education programmes. All institutions had encountered difficulties in the provision of practical work in distance education programmes.

Staff Recruitment and Training

In many areas of science and technology there has been a traditional difficulty in recruiting teaching staff with appropriate scientific or industrial experience. This situation is often exacerbated for institutions offering courses by distance education. In these institutions there is often an emphasis on teaching and consequently less opportunity to engage in research and development activities than in traditional universities. Teaching staff are also expected to have or to acquire considerable knowledge and skills in the areas of curriculum design and distance education technology and practice.

Also, where institutions require students to undertake practical work at regional study centres under the supervision of a tutor or laboratory assistant, difficulties have been encountered with the recruitment and training of suitable people. These personnel need to be competent in the use of all of the equipment at the centre, as well as being able to assist students with their studies; they must also fulfill a technician's function and ensure that the equipment is maintained in good working order.

Recognition of Courses

Problems noted concerning the recruitment of academic staff for distance education courses in science and technology may be worsened by the perceived lack of recognition for such courses and programmes. Whilst the use of distance education for non-science and technology courses has become widely accepted in recent years, there is still considerable scepticism concerning the offering of science and technology courses by this mode of study. Much of this uncertainty stems from members of the scientific and technological, academic and professional community. Participants felt that more

promotion of science and technology courses and programmes by distance education is required to increase awareness of their quality and cost effectiveness.

Student Enrolment

All participants noted that enrolment in science and technology programmes available by distance education had tended to be lower than in other discipline areas, such as arts and humanities. The reasons for this disparity are not clear. There are often real disincentives such as increased fees for students enrolling in science and technology programmes. However these discipline areas may be perceived by prospective students as being more difficult to study by distance education, and lacking suitable compensating rewards upon completion.

Financial Considerations

The cost of developing and implementing courses in science and technology by distance education is significantly higher than for courses in other discipline areas. The major contributing factor to the high cost is the requirement of most programmes for a large component of practical work. Participants considered a number of alternative methods of providing practical work experience to students, for example, through regional study centres, attendance at a central facility, home experiment kits and computer simulation. However, each involved a significant development or implementation cost. Other factors also contributed to the high cost of these courses. Because of the lack of availability of suitable low-cost textbooks, there was generally a need to develop comprehensive study materials which then required to be updated on a more regular basis than those for other subject areas. Also computer access, whilst highly desirable in many discipline areas, is an essential prerequisite for study in most science and technology courses.

Most institutions were dependent upon government funding for the continuation of distance education programmes. If this source of funding is to be increased, governments must be made aware of the needs for courses in science and technology, and of the quality and cost effectiveness of such courses by distance education. However, all participants recognized the need to seek alternative sources of funding for these programmes. The potential problems associated with passing the higher costs on to students in the form of higher course fees have been noted previously. Therefore, this action could only be justified where increased rewards, in the form of employment or advancement opportunities, were accrued by students on completion of their studies. However, science and technology courses could be targeted to meet the needs of industry and several institutions were investigating the adoption of this approach to obtain increased revenue. Co-operative ventures between participating institutions were also seen as a major opportunity to significantly reduce the costs of offering science and technology courses and programmes by distance education.

Co-operative Ventures

Co-operative ventures between institutions engaged in distance education activities were perceived to offer considerable potential for cost reduction, in particular for programmes in science and technology. The conventional economics afforded by the creation of data banks of study materials would be greater for science and technology courses because of the greater development and recurrent cost of study materials and practical work programmes in such courses. Further, savings may accrue from the exchange of staff with specialist subject knowledge and appropriate experience in distance education, the standardization of home experiment kits that would allow for their mass production, and the possible utilization of shared practical work facilities.

Chapter Two

APPROACHES TO THE DEVELOPMENT OF SCIENCE, TECHNOLOGY AND OUTREACH PROGRAMMES BY DISTANCE EDUCATION

In the previous section, some of the major problems commonly associated with the conduct of science, technology and outreach programmes by distance education have been identified. In this part of the report a strategy and methodology for the development of such courses is proposed. The development of programmes in science and technology is a complex and dynamic process with many unique problems. It is imperative therefore to provide a framework or structure to facilitate this task. The methodology in this section has been formulated from the experiences of all of the delegates participating in the workshop and represents an ideal and comprehensive approach to programme development. It is recognized that many institutions may not be able to adopt this approach to programme development in its entirety. However, the proposed methodology identifies many of the factors that are important in the development of science, technology and outreach programmes and provides a structure or framework for their consideration. If it can be used as a guide, many of the difficulties that may be encountered in offering such programmes by distance education may be avoided or minimized.

It should be noted that the proposed strategy and methodology is equally applicable to all types of programmes. Whether the

programme of study is extensive and leads to the award of a degree in science or technology, or it is a condensed programme designed to suit the needs of a specific industry, the same factors need to be taken into consideration, and this should be done in a logical sequence.

Finally the methodology outlined in this section applies not only to the development of new courses but should also be used to analyse the viability of existing courses. It is essential to review existing courses frequently and to compare their merits with those of the proposed new courses. When funding is limited, it may be necessary to discard some existing courses in order to provide the resources to undertake new ventures.

The proposed strategy and methodology follows closely the analysis that would be made by any business organization when considering new and existing projects. Increasingly higher education establishments are required to be more accountable and productive, so it is appropriate that techniques of business analysis are utilized when considering the introduction of courses. These institutions are concerned with the development of a "product" or "education service" in much the same fashion as any commercial enterprise.

Identification of Programmes to Be Offered

The first stage of the process is concerned with the identification of programmes that should be developed. The workshop considered that this identification process should occur in two stages:

Market Analysis: It is necessary first to establish where there are needs or perceived demands for programmes in science and technology by distance education. In other words, an institution must endeavour to identify possible markets. It is not essential to substantiate the need for a programme at this stage as it is more appropriate to do this during the evaluation phase, when the nature of the proposed programme has been established in more detail.

As with any business, it is advantageous to be forward looking rather than reactive. Future demand may be predicted by studying industry manpower requirements, economic reports and developments in other countries. Formal surveys of industry in an effort to establish future needs have also been used extensively by Sukhothai Thammathirat Open University.

It is also important to be quite clear about whose needs are being considered. It may be the perceived needs of industry for certain types of employees, the needs of governments or the personal needs of individuals. This will have a major influence on the objective of the programme as well as programme design and evaluation.

Consideration should also be given to the promotion or stimulation of demand for a programme. Institutions of higher education have a social responsibility to identify the future needs of a community and to endeavour to cater for them. Within this context it is possible to lobby governments, industry and the general community in order to create an awareness of the need for a particular programme.

Analysis of the Capabilities of the Educational Institutions: The second stage of the process involves an analysis of the educational institution to establish its strengths and limitations. Business experience has shown that there is a high rate of success for ventures in which perceived needs can be satisfied using the strengths of an organization. Equally, attempting to satisfy needs in areas where the organization has significant limitations will often result in failure.

This dual process for the identification of science and technology programmes to be offered by distance education has been used with considerable success by Sukhothai Thammathirat Open University and Darling Downs Institute of Advanced Education. In the case of Sukhothai Thammathirat Open University, formal surveys of industry revealed the need for many programmes; the

decision on which programmes would be considered for further development was then based on an analysis of the University's capabilities. For example, whilst the need existed for programmes in civil and mechanical engineering, these options were discarded in favour of programmes in industrial technology and information systems where the existing infrastructure could be used and extensive laboratory facilities were not required to be developed.

Darling Downs Institute of Advanced Education was able to build on its experience of offering associate diploma programmes in engineering by distance education and of offering a bachelor of engineering programme by full-time, on-campus study, to develop a degree programme in engineering that is primarily undertaken by distance education.

Delegates at the workshop considered that it was important to guard against the development of programmes where there was no clearly defined need or perceived demand. Also the duplication of programmes that are better accommodated by full-time, on-campus study should be avoided. The latter course of action should only be contemplated where existing conventional establishments are incapable of satisfying the demand for a particular programme. Two of the institutions represented at the workshop derive the bulk of their recurrent income from student fees and this provided a clear and immediate indication of the continuing need for a programme.

The workshop noted that there would be some instances where the need for programmes was dictated by governments. This obviates the need for the identification process but poses other problems.

At the conclusion of the identification process, it should be possible to indicate several programmes that warrant further investigation. No attempt to prioritize the programmes should be

attempted at this stage, since more detailed analysis is required before this is feasible.

Development of Programmes

When several possible programmes have been identified, it is necessary to investigate each programme in more detail. This process may be broken down into three stages, namely: a) the nature of the proposed programme; b) recognition of the programme; and c) programme design and implementation.

The Nature of the Proposed Programme: It is essential to specify the major objective of the programme clearly and in some detail. It is not sufficient to state that the programme is "intended to train technologists for the manufacturing industry", for example. This is too vague. Participants also considered it necessary to indicate for whom the programme is intended, the level of prerequisite skills and knowledge that are assumed and what is required of students to complete the programme. This information is essential for programme design and implementation. It will assist considerably with the specification of the nature of the programme if the market analysis has been done correctly.

In many countries, open universities operate distance education courses and often it is a policy of these establishments to have "open entry" to their programmes. This is an admirable concept but may result in significant problems for programmes in science and technology. Many institutions have adopted flexible structures that include courses that provide knowledge and skills at a basic level, in an effort to cater for the diversity of the educational standard of students entering their programmes. But participants noted that there were special difficulties in science and technology programmes. Whereas the prerequisite skills needed to successfully study programmes in business, for example, may be further developed after leaving school, this was not the case in science and technology.

Analytical and mathematical skills are not utilized routinely in everyday life and these skills therefore deteriorate rapidly after leaving school. The participants from institutions in India and Pakistan, in particular noted that some students may never have been provided with these particular skills at school in the first instance. These weaknesses were not overcome by flexible programme structures and were a contributing factor to the high attrition rates in science and technology programmes. Whilst data are not available for science and technology programmes in many countries to date, it was revealed at the workshop that in Sri Lanka and Australia attrition rates of the order of 45-65 per cent were experienced. Participants from other countries indicated that attrition rates for non-technological courses were approximately 33-50 per cent.

It is essential to reduce these attrition rates if the programmes in science and technology are to be attractive to students, and acceptable in terms of progression rates. Therefore careful attention must be given to the aspirations of students and the level of their knowledge and skills. Programmes must not only clearly indicate the knowledge of basic science and mathematics and of communication skills that is assumed, but also indicate precisely what is expected of the student in terms of workload. At Allama Iqbal Open University prospective students are often provided with brief examples of study materials and self assessment instruments. Students may therefore gain an indication of their chance of success in a course or programme before they formally enrol. Many participants also expressed the concern that students are unaware of the rigours of study at the higher education level and of the impact that it will have upon their social lives. So it is not only necessary to provide courses in basic science and mathematics, it is also vital to include courses on how to study by distance education successfully.

Recognition of the Programme: For a programme of study to be relevant it must be acceptable to one or more of the following bodies: a) professional bodies; b) employers; c) government instrumentalities; d) prestigious educational establishments; and e) the general community.

For short programmes designed to suit the needs of a specific employer for in-house training of employees, only the recognition of the employer is necessary. However programmes normally must be acceptable to more than one of the above groups. In general terms, the more a programme is acceptable to these groups, the greater will be its attractiveness and hence its demand.

Acceptance of a programme will depend to a large degree upon the extent to which it is believed that it can achieve its stated objectives and this will depend upon programme design. Several participants at the workshop have indicated that this process can be facilitated by inviting representatives of professional bodies and major industries to serve on programme development and evaluation committees.

Programme Design and Implementation: It is of primary importance that the programme is designed and implemented so that the programme objectives are capable of being achieved by an acceptable proportion of participants. However it is also necessary to balance this aspect of programme design with the attractiveness of the course to students. The latter aspect is important because it influences demand for the programme and ultimately the cost effectiveness and viability of the programme. Also the programme design and implementation must take cognizance of the existing infrastructure for distance education that exists at the institution, since the development of new media for delivery may be expensive.

There are a number of particular difficulties that are associated with the design and implementation of programmes in

science and technology by distance education. Firstly, suitable textbooks are only produced in a few countries and are often expensive and difficult to obtain. Further, the nature of science and technology is such that textbooks are constantly being updated. For science and technology programmes therefore, there is usually a greater need to produce composite study materials for students, that do not require any specific textbook. Secondly, courses in these programmes tend to involve high levels of practical work. Which often requires access to sophisticated or expensive equipment. Lastly, programmes in science and technology require increasing access to computing facilities.

The high cost associated with the preparation of comprehensive study materials for each course in a programme can be defrayed by co-operative ventures between distance education centres. Darling Downs Institute of Advanced Education has undertaken an evaluative study for the Australian Commonwealth Tertiary Education Commission on the implication of sharing the costs of preparation of study materials with other institutions.

The cost of preparation of the study materials may also be alleviated if the materials can be used in courses of other programmes offered by the same institution. For example, study materials for a course in introductory computing may be utilized in both degree and diploma programmes, and in outreach programmes. Preparation of study materials in modular form will considerably assist in either of the two situations outlined above.

The most significant of the difficulties of conducting science and technology programmes is that of practical work. There are several factors that should be considered in this regard.

It may be possible to select programmes in science and technology that by their nature have very low levels of practical work. For example Sukhothai Thammathirat Open University has targeted to

upgrade extension programmes for students who have already completed programmes that were heavily practical work oriented. Such students have extensive practical experience and are therefore primarily in need of theoretical knowledge. This approach allows funding from student fees without the necessity to establish expensive laboratory facilities and provides an ideal method of introducing science and technology programmes into an institution.

Where such an approach is not possible, it is first necessary to question the level of practical work that is required in the programme. Many programmes in science and technology evolved in an environment where practical work could be undertaken with comparative ease. The workshop considered that it was necessary to attempt to evaluate carefully the requirements for practical work in any distance education programme rather than just to accept an existing situation.

One must accept, however, that some practical work is essential in science and technology programmes. There are a number of ways of accommodating practical work in distance education programmes. These include :

Residential Schools: Several factors should be considered with regard to the use of residential schools. It is important to establish the number of days of residential school that are acceptable to students and their employers. This must then be balanced against the educational requirements of the programme. The length of residential schools will vary depending upon the level of the course, the requirement to develop practical skills and the local conditions within each individual country. For programmes offered by the Open University of Sri Lanka a period of approximately 20 days per year seems to be acceptable with an additional period of 21 days once during their programme for students in technology programmes. For diploma and degree programmes offered by Darling Downs Institute

of Advanced Education, residential school periods of five or six days per year are more prevalent.

The location of the residential schools is a related matter. A central facility may necessitate students travelling large distances; they may also have difficulty in finding suitable accommodation when numbers are large. A central facility is very cost effective for the education establishment but expensive for the student. Generally residential schools using this approach will be short and held only once a year. Where residential schools are arranged at regional centres, the cost and inconvenience to students is reduced and residential schools may be longer and more frequent. However, the cost of duplication of equipment and of staffing may be high unless the facilities of other appropriate institutions can be utilized.

Home Experiment Kits: These have been used successfully by several institutions. They are not appropriate however for foundation level courses where students may have no prior experience of scientific method.

Computer Simulation: This requires access to a microcomputer but is particularly effective in certain types of courses, for example, electronics, microprocessor system design and engineering drafting. Microcomputers may be available at regional study centres or students may have access to a computer at their place of employment. In some countries, it is realistic to expect students to purchase or lease microcomputers and peripheral hardware, as the cost is reasonable and is likely to fall substantially. Many students will continue to utilize microcomputers after graduation from their programmes.

It is necessary to decide at an early stage whether access to a microcomputer will be a programme requirement as this can profoundly influence the nature of study materials developed in various courses in the programme.

Use of Facilities in Industry: This has traditionally been accomplished through the use of "sandwich" type programmes. It is unlikely that any commercial organization would make its facilities available to significant numbers of students. However, as industry is increasingly the repository of much of the more sophisticated technological equipment, it may be feasible to allow credit in programmes for in-house training on such equipment undertaken at a student's place of employment, and exempt the student from attendance at residential school.

It is essential to look at the structure of the programme when considering any provision for practical work in science and engineering programmes . Students should not be required to invest large amounts of time and money in the course, nor should institutions establish practical facilities for large numbers of students at the first level of a programme until both parties have had the opportunity to assess the students' chance of successfully completing the programme.

Planning for Implementation

When the preliminary programme design and method of implementation has been established, it is necessary to consider the human and physical resources necessary to implement the programme.

Physical Resources: To some extent this topic has been covered in the section on residential schools. For science and technology programmes and outreach programmes containing a major component of science or technology, establishing laboratories or workshops and purchasing equipment must require considerable expense. The workshop identified the following possibilities of reducing this cost.

The facilities can be established at one central location. In effect this passes some of the cost to the students, who must travel to

the central facility and pay for accommodation there. This may be acceptable where the distances involved are not great and the educational establishment has surplus or cheap residential accommodation.

The facilities can be established at a number of regional centres. This involves considerable expense for the institution but reduces the cost and inconvenience for students. In science and technology programmes, where equipment is expensive and may have to be updated on a regular basis, the cost of this approach could be prohibitive. This would be especially true if the facilities were to be idle for long periods of time between residential schools. Further, in many instances, trained technical staff will be needed to operate the equipment and this expertise will not be readily available in some cases. Even if suitable people are available, it may not be possible to employ them on a casual basis.

Existing facilities may be used in total or in part. The most promising venues would be other educational institutions offering full-time, on-campus programmes in science and technology. This is because both the equipment and expertise to supervise students in its use, reside in one place. With the cost of a single numerical control machining centre approaching US $250,000, co-operative ventures between educational establishments would seem to be the most promising approach. These facilities exist in industry of course, but it is unlikely that any commercial organization would allow the use of any of its equipment by anyone other than its employees. So this avenue is not very promising where significant numbers of students are involved.

The students may be able to purchase or lease equipment suitable for some courses or programmes. For example, both Sukhothai Thammathirat Open University and Darling Downs Institute of Advanced Education are likely to require students to have access

to microcomputers and peripheral hardware for some courses. Leasing of this equipment offers obvious advantages for most students, but this would generally require the educational institution to work in co-operation with a manufacturing or supplier of such equipment, as the institution is unlikely to be able to afford the establishment cost of such a programme.

Human Resources: Recruitment of suitable staff is a major problem for several institutions. It is common for open universities in the region to rely on academic staff from other institutions to prepare the textual subject matter of study materials. In this context many participants have indicated that it is difficult to obtain staff with expertise in the subject area and a commitment to the production of high quality materials within an agreed schedule. It is also necessary to recruit staff for regional study centres.

The training of staff is also an important consideration. Many participants noted that the academic staff of institutions conducting courses by distance education needed not only to have a good knowledge of their own discipline area but must also be familiar with an extensive range of instructional media and have good management skills in order to supervise the preparation of study materials and conduct of the courses. Staff members needed to be supportive of distance education and aware of the external constraints that impact upon the conduct of courses offered by distance education. In order to function effectively within constraints, staff members needed to be innovative and flexible in their approach.

To instill such skills in members of staff requires extensive training. To date most institutions have been fully occupied in the preparation and provision of distance education courses and have been unable to devote sufficient time to the education of their own staff. This results in inefficiencies of operation as many staff members continue to learn a substantial part of their job by experience.

Formal training is not only given insufficient emphasis within individual organizations, but formal network among organizations is also absent offering no means for staff members to benefit from the experience of other institutions. This is particularly unfortunate because in science and technology programmes the cost of mistakes is often very high.

Organizational Aspects: The final stage of planning for the implementation of programmes is the consideration of amendments to the organization for distance education that may be necessary or desirable to accommodate its new programmes.

In some institutions all of the necessary expertise and facilities exist to design, prepare, produce, and conduct programmes by distance education. Such institutions may also offer their programmes by full-time, on-campus study. More often institutions have a comparatively small core of academics staff and must rely heavily upon external agencies for the preparation of course materials and the conduct of distance education courses. It is evident from the reports of participants that the greater an institution has to rely on external agencies, the less control it has over the process. In this scenario, management of the process assumes a greater importance. It has been noted previously that increased co-operation between institutions engaged in distance education activities and other bodies is of major importance when developing programmes in science and technology.

It is necessary to consider the organizational aspects associated with all phases in the design and conduct of distance education programmes because it may have a profound influence on curriculum development and implementation. For example, the difficulties associated with simultaneous examinations of large numbers of students at various locations can be a major organizational problem. Central Radio and Television University of China limits

such examinations to four per year. Thus it is evident that organizational difficulties can determine the method of assessment of student performance. The implications for conducting assessments of students' practical abilities must be evident.

Evaluation of Courses

After consideration has been given to the development and implementation of programmes by distance education, it is necessary to cost and evaluate each programme in order to establish a priority listing. A major consideration in this process is the anticipated number of students who will enrol in the programme and at this stage it is appropriate to conduct surveys of prospective students in order to ascertain the demand. An accurate indication of demand can only be obtained after details of the programme design and proposed method of implementation are enunciated. The Allama Iqbal Open University also conducts pilot programmes to assess demand for courses.

When a reliable estimate of the number of enrolled students is obtained it may be necessary to review the nature of the proposed programme, the programme design and the implications for implementations. Thus it can be seen that not only are components of the methodology interactive but also the process itself is reiterative.

In evaluating the proposed programmes, methods of cost reduction should be analysed and additional sources of revenue should be investigated. Several ways of reducing costs have been cited in the body of this section. They include: a) targeting of science and technology programmes that are most appropriate to offer by distance education; b) co-operation with other institutions in the development of study materials, dissemination of information and utilization of physical facilities; and c) increased productivity through training of staff.

It is pertinent to recall that this analysis should also be applied to existing programme in order to free resources for the introduction of a new programme that will benefit a greater number of students. Institutions that offer science and technology programmes by distance education have a unique opportunity to raise revenue by utilizing courses within these programmes to service specific needs of industry and to provide continuing education opportunities for practising scientists, technologists and engineers. A general trend exists for professional societies within these fields to insist upon evidence of continuing education in order to retain membership. Study materials of higher quality may also be sold to other educational establishments for conduct of full-time, on-campus programmes. This may be beneficial to such institutions where they are understaffed or are unable to obtain academic staff with appropriate expertise in narrow, but important subject areas.

Chapter Three

POLICY ALTERNATIVES AND MEASURES FOR AUGMENTATION OF SCIENCE, TECHNOLOGY AND OUTREACH COURSES

There are a number of different ways in which this can be viewed. The workshop classified matters relating to policy in a functional manner as follows: choice of programmes (outreach, diploma or degree, or postgraduate programmes); staff development (special needs, separate unit); funding and course fees (state funding and non-traditional source); and investment alternatives (development of printed course materials, audio-visual materials, delivery systems, regional networks, or laboratory and computing facilities).

Policy can also be made at different levels. For the purpose of this report, two levels have been considered: university level and national level.

Choice of Programmes

At university level, decisions regarding the choice of programmes have to be made by the academic community. Different mechanisms for implementing these are available and have been tried out in different institutions. Satisfactory arrangements have to be evolved, taking into account the peculiarities of each situation. Universities should actively investigate co-operation with other institutions, local, regional and international, in the matter of the choice of courses. At the national level, especially in cases where new

or additional resources are required, the university will have to convince funding agencies of the desirability of selecting a particular programme for development. When such proposals originate from them, they would in turn have to convince the relevant university academic body (such as the senate).

Outreach Programmes: There is a great need for the open universities in the region to offer courses that are aimed at providing very necessary skills and even information to either the mass of the people or to specific identified groups. In most of these countries, which do not possess a well developed market economy, the identification of programmes to be offered has to take into account the social accountability of the university. It would be very desirable if at least some of these programmes, especially those that have to be offered at comparatively short notice, be developed from existing long-term programmes by suitable adaptation.

Universities should develop sufficient visibility to attract outside organizations, whether they be government institutions and departments or private industry, when they have a need for an identifiable teaching or training programme, especially where distance teaching methods are more suitable. However, the university should accept such an assignment only when it fits into the overall development plan of the university, or in very exceptional cases, when there is an urgent national need.

Diploma/Degree Programmes: A diploma or a degree programme in a science based area needs a large amount of resources. It should only be offered when resources will certainly be made available. Even though, ideally, such a decision can only be made when the university has actually got the required resources within itself, this is not practicable in the context of the real situation prevailing in most of the countries in the region. A more viable approach would be to first identify the necessity to offer a particular

course by an academic committee within the university, augmented by suitably qualified persons from other institutions. Once a project is identified, it will then be possible to seek funding, staffing and other necessary facilities while the planning process is in progress.

In developing programmes of this nature, great care has to be taken to ensure that the course developed is suitable for distance education and that the curriculum is relevant to the needs of the prospective students. This task is made more difficult by the fact that public expectations would tend to direct the planners to conform to the pattern of existing conventionally taught courses. This is even more so in the case of professional courses, such as in engineering, where acceptance by professional institutions will be a requirement.

It is necessary that the position of an open university as an organization that promotes the democratization of education be emphasized when new programmes are proposed, especially at this level. In most countries in the region, tertiary education is still a luxury and only a comparatively small proportion of the population has access to it. It is also one of the few means of social mobility that is available to the poorer sections of the people. The rigid structure of the conventional tertiary education system does not, however, allow much scope for all those who would wish to take part in this process. Hence, the open universities carry a heavy social responsibility in providing such opportunities. Further discussion will be under the heading of 'funding and course fees'.

Postgraduate Programmes: The choice to offer postgraduate programmes in an open university will be made in a manner similar to that of a degree programme.

Research based postgraduate programmes are necessary for yet another reason, namely, for the establishment and maintenance of a qualified academic community. If a faculty is to attract and retain quality academic staff, they have to be provided with adequate re-

search opportunities. Where the university itself finds it difficult to provide the necessary facilities, joint programmes with established research institutions may be undertaken.

The open universities should also both encourage and recognize research in the methodology of education, with special reference to the teaching of science and technology programmes at a distance.

Staff Development

Each open university should establish a separate unit for the selection, recruitment and training of academic staff, with special emphasis on the needs of science and technology programmes. Training will take into account the requirements in respect of: distance education, science and technology education, guidance for tutors, and course specific training.

Funding and Course Fees

Funding is a very important aspect in the operation of any institution. In the case of open universities, at least in some of the countries, there is a noticeable move away from the tradition of state funding that is prevalent in the conventional universities in the region. There are a number of understandable reasons for this tendency. However, there is a case to be made for a higher level of state funding, in view of the role that the open universities have been called upon to play: in meeting national educational needs, in providing opportunities for the underprivileged and in providing science, technology and outreach programmes.

In those countries where a substantial part of the cost of a programme has to be generated by the university, the fees charged from the students tend to be rather high. This is particularly so in the case of courses in science and technology, because of the higher cost of production as well as delivery, including laboratory classes. In these cases, it is necessary that the principle of fees being related to

the average earning power of the target population rather than to the cost be accepted by the funding authorities.

Investment Alternatives

The relative importance of the computing demands on available resources is to be determined by the academic authorities, in respect of each course. Some of the more important factors are: medium (printed material, audio-visual aids, computer based teaching material); delivery system (regional centres, tutoring, teleconferencing); and laboratory and computing facilities.

Medium: The cheapest medium is print. This is also the most important and most widely used medium. The workshop was of the view that the print media will continue to occupy this pre-eminent position in the foreseeable future in the teaching of science and technology courses. There are some situations where audio-visual media have an advantage over print. One such case is when it is necessary to reach a very wide audience of low educational background. In some cases, the target audience may even be illiterate. Special arrangements need to be developed with the national broadcast and television media, especially for the delivery of the outreach programmes.

Audio-visual media are also useful in presenting certain parts of a course which is otherwise taught mainly through the print media. For very specific applications, such as the teaching of elementary language (English) skills and also in some sophisticated simulation studies, computer based teaching material are of interest. The course teams should be responsible for selecting the correct mix of the different media available to them.

Delivery System: Regional centres play a pivotal role in the operation of the open universities. Given the high cost of transport, both in terms of money and time, a good regional network is an essential component of the delivery system. Emphasis should also

be placed on the development of a satisfactory tutoring system, including personal tutoring, based on the regional or study centres. Given the state of the telecommunication networks in the region, it is unlikely that sophisticated tele-conferencing and other modern communication systems will be of any significant importance in the near future. Institutions should be wary of investing in such facilities, especially in the light financial situation that all the open universities find themselves in.

Laboratory and Computing Facilities: Laboratory experiments are an integral and compulsory component of almost all courses in science and technology. This is also an expensive component. In an open education system, it is also a constraint on the students as they have to make arrangements to participate in this activity. Every effort should be made to make maximum use of the time spent by the student at a centre for the purpose of taking part in laboratory work. Provision of in-house residential facilities will help to reduce the duration of residential courses, and this should be given high priority. The use of the facilities available at other universities and colleges should be actively pursued.

With the dramatic reduction in the cost of computing equipment, it is now becoming possible to provide access to computers at regional and/or study centres, and advantage should be taken of this to augment the laboratory classes by suitable simulation experiments. This will help to keep the costs down, without compromising standards but will only be possible for the diploma or degree and post-graduate programmes, and for selected outreach programmes. It may not be feasible in the case of outreach and certificate level courses conducted through the national languages.

Chapter Four

CO-OPERATION AMONG INSTITUTIONS

The workshop noted that the annual budgets allocated by governments for supporting educational purposes in the participating institutions are rather insufficient. It was of the view that the universities should endeavour to augment existing resources by requesting the co-operation of various agencies, both in the public and private sectors, to assist in the university's operations. Apart from the local agencies, they should also co-operate with international organizations, both regional and international. In particular, they should seek co-operation among the open universities.

Science, technology and outreach programmes are new to most of the open universities in the region. Even though some open universities have commenced offering science and technology programmes, they are still at the very early stages and need further development. It is anticipated that co-operation will result in the improvement of the quality of the programmes and that better cost effectiveness can be achieved. Co-operation can be bilateral among the existing institutions or multilateral, through associations. It can also be at different levels: national, regional and international.

Introduction and administration of programmes in science and technology is more difficult than those in social sciences. This is because they involve practical work and special teaching media. Co-operation with external agencies is necessary in order to obtain resources, experience, know-how and assistance for strengthening

the programmes. The main objectives of such co-operation would be to improve the quality of the programmes, achieve better cost effectiveness and get wider acceptance of the programmes.

The workshop was of the view that co-operation should be based on mutual benefits. Since the science and technology programmes of these institutions are new and not well known to the general public, it may not be easy to get co-operation at the beginning. The workshop felt that the universities should actively seek co-operation with existing institutions and agencies by the following strategies :

Institutionalizing multilateral co-operation by establishing suitable linkages to interact with the relevant agencies.

Establishing good public relations at the national level, to ensure wider acceptance, participation and co-operation. Needs and demand assessment will help in the identification of potential partners.

The potential agencies for co-operation can be broadly classified into three. Firstly, at the national level, institutions that possess facilities that are useful to the university are good potential partners. Use of facilities available at other agencies is to be encouraged since the resources of the open universities are limited. On the other hand, these agencies can benefit from the academic services of the open university as well.

At the regional level, co-operation among the open and distance teaching universities in the region is important for their future developments. They can make use of the services of the existing distance education agencies, e.g. Asian Association of Open Universities and the Regional Resource Centre in Distance Education (both located at STOU, Thailand). These organizations have been established recently in co-operation with UNESCO.

Lastly, co-operation can be at the international level. Since the open university concept has an international character, co-operation with the open universities in other regions, international agencies and associations will be of great benefit to the development of open learning systems in the region. Among potential partners for international co-operation are : UNESCO, The British Council, Japan International Co-peration Agency, Canadian International Development Agency, International Development Research Centre, International Council for Distance Education, University Without Walls International Council and the newly established Commonwealth for Learning.

Areas of co-operation among the open universities in the region can be in utilizing existing facilities and equipment and in sharing staff expertise. Establishing joint-venture programmes in producing learning materials, exchange of existing materials, and sharing and exchanging experiences in teaching science, technology and outreach programmes should be encouraged.

Chapter Five

SUMMARY AND CONCLUSIONS

The Workshop identified a number of difficulties in the design and implementation of programmes by distance education that it believed were exacerbated for programmes in science and technology. These particular problems are noted below.

All participants encountered problems with the provision of practical work which is an integral and often compulsory component of science and technology programmes.

Difficulties with the recruitment and training of suitable personnel to prepare instructional materials and to conduct programmes were experienced by most participants.

The Workshop noted that, whilst the use of distance education for non-science and technology courses has become widely accepted in recent years, there is still considerable scepticism concerning the offering of science and technology courses by this mode of study.

Participants indicated that enrolment in science and technology programmes available by distance education has tended to be lower than in other discipline areas. This may be because they are perceived by prospective students as being more difficult to study by distance education, and lacking suitable compensating rewards upon completion.

It was noted that the cost of developing and implementing courses in science and technology by distance education is significantly higher than for courses in other discipline areas. The higher cost was associated with a number of factors including the provision of practical work, the lack of availability of suitable, current textbooks which necessitated the development and maintenance of comprehensive study materials, and the need to provide access to sophisticated equipment, including computing facilities.

By way of conclusion, the Workshop was able to make a number of suggestions concerning the development and provision of science and technology programmes by distance education. It was hoped that the adoption of these recommendations would alleviate many of the problems that were identified. A summary of the principal recommendations contained within the body of the report is presented below.

Increased Recognition: The workshop reiterated that there is a need for increased recognition of the importance of offering science and technology programmes by distance education. Institutions should promote these programmes vigorously.

Sound Methodology: Because of the high costs and organizational difficulties associated with the provision of science and technology programmes by distance education, the Workshop considered it essential to adopt a sound methodology for the development of such programmes and to establish a planned pattern for their introduction.

Participants at the Workshop considered that it was important to guard against the development of programmes where there was no clearly defined need or perceived demand. Also the duplication of programmes that are better accommodated by full-time, on-campus study should be avoided. This latter task was often made difficult by the fact that public expectations tended to direct planners to

conform to the pattern of existing conventionally taught courses. This may be more evident in the case of professional courses, such as in engineering, where acceptance by professional institutions is normally a requirement.

Practical Work: Practical work is an integral and often compulsory component of all programmes in science and technology and the participants at the Workshop considered the relative merits of a number of alternative methods of providing practical work experience to students. These included the use of regional study centres for practical work, attendance at a central facility, leasing of equipment, home experiment kits, co-operative ventures with industrial and scientific organizations and computer simulation. The perceived advantages and limitations of each of these approaches are detailed within the body of the report.

Prior to evaluating the most appropriate avenues for providing students with practical work experience, the Workshop recommended that the level of practical work required in the programme should first be investigated. Many programmes in science and technology evolved in an environment where practical work could be undertaken with comparative ease and the requirements for a similar level of practical work in a distance education programme should be carefully evaluated, rather than just accepting and adapting an existing practice.

The participants felt that the dramatic reduction in the cost of computing equipment, warranted serious consideration of the use of computer simulation to reduce the level of practical work in distance education programmes. Students should not be required to invest large amounts of time and money in the course, nor should institutions establish practical facilities for large numbers of students at the first level of a programme until both parties have had the opportunity

to assess the students' chances of successfully completing the programme.

The cost of preparation of study materials may be reduced considerably if the same materials can be used in courses of other programmes. For example, study materials for a course in introductory computing may be utilized in degree and diploma programmes, in outreach programmes and probably in programmes offered by other institutions. Preparation of study materials in modular form will considerably assist with this approach.

Staff Training: It was noted that to date most institutions offering science and technology programmes by distance education have been fully occupied in the preparation and provision of distance education courses and have been unable to devote sufficient time to the education of their own staff. This results in inefficiencies of operation as many staff members continue to learn a substantial part of their job by experience. Formal training is not only given insufficient emphasis within individual organizations, but in the absence of any formal network, staff members are unable to benefit from the experiences of other institutions. Each open university should establish a separate unit for the selection, recruitment and training of academic staff, with special emphasis on the needs of science and technology programmes.

Careful Selection of Students: In many countries, open universities operate distance education courses and often it is a policy of these establishments to have "open entry" to their programmes. This is an admirable concept but may result in significant problems for programmes in science and technology. In particular attrition rates for such programmes may be very high. It is vital that attrition rates are reduced if the programmes in science and technology are to be attractive to students, and acceptable in terms of progression rates.

The Workshop emphasized that careful attention should be given to the aspirations of prospective students and the level of their knowledge and skills. Programmes in science and technology by distance education must not only clearly indicate the knowledge of basic science and mathematics and of communication skills that is assumed, also indicate precisely what is expected of the student in terms of workload.

Funding: Most institutions were dependent upon government funding for the continuation of distance education programmes. If this source of funding is to be increased, governments must be made aware of the needs for programmes in science and technology, and of the quality and cost effectiveness of such programmes by distance education. Governments should be lobbied to provide differential funding for science and technology programmes in recognition of the higher costs incurred by institutions offering such programmes.

Alternative Sources of Funding: The Workshop recognized the need to seek alternative sources of funding for these programmes. Institutions that offer science and technology programmes by distance education have a unique opportunity to raise revenue by utilizing courses within these programmes to service specific needs of industry and to provide continuing education opportunities for practising scientists, technologists and engineers. There is a general trend for professional societies within these fields to insist upon evidence of continuing education in order to retain membership. Study materials of higher quality may also be sold to other educational establishments.

Profile Development: Institutions should develop a profile that is attractive to external organizations that have needs for specific teaching or training programmes, especially where distance education methods are appropriate. It was noted that this process can be facilitated by inviting representatives of professional bodies and

major industries to serve on programme development and evaluation committees.

Consideration for Fee Increase: Passing increased costs on to students in the form of increased fees may be counterproductive and may decrease the number of enrolment in a course or programme. This action could only be justified where increased rewards in the form of employment or advancement opportunities were accrued by students on completion of their studies.

Institutional Co-operation: Co-operative ventures between institutions engaged in distance education activities and between other public and private organizations were perceived to offer considerable potential for reducing the costs of offering science and technology courses and programmes by distance education, and for improving their quality. Areas of co-operation could include the exchange of staff with specialist knowledge, the utilization of shared practical work facilities and equipment, the development of standardized home experiment kits, and the joint development of study materials and exchange of existing materials.

Research: Open universities should both encourage and recognize research in the methodology of education with special reference to the teaching of science and technology programmes at a distance.

Appendix A

PRESENT STATUS OF SCIENCE, TECHNOLOGY AND OUTREACH PROGRAMMES AND COURSES IN THE PARTICIPATING INSTITUTIONS

In this section of the report a summary is presented of the current status of science, technology and outreach programmes in the participating institutions.

Within this report the term "course" is used to denote the smallest component of a programme of the study for which a separate final grade or result is officially recorded. In some countries the terms "subject" or "unit" may be used. The term "programme" is used to denote a group of courses which, if successfully completed, will normally lead to the conferring of a recognized award, such as a diploma or degree. Outreach programmes however do not lead to the conferring of a recognized award, although some statement indicating successful completion of the programme is normally given by the institution conducting the programme. Outreach programmes are also called "extension studies" and "continuing education courses" in some countries. In this report, only outreach programmes that have a significant component of science or technology are considered.

General Observations

There is a wide diversity in the development of distance education institutions and also in the range and level of courses and programmes offered by these institutions. Thus in Papua New

Guinea, there are relatively few courses offered reflecting a fairly low student population, as compared to Allama Iqbal Open University in Pakistan where there is a large range of courses catering to a student population of some 120,000 students. Similarly, the sophistication level of the course materials and media of instruction varies enormously from those centres which rely entirely on the printed text to centres like those at the Darling Downs Institute in Australia, where audio-visual techniques and the use of computer hardware supplement the more conventional means of instruction.

However throughout these different reports, there emerge some common approaches as well as similarities in problems which are faced. One common approach occurs in terms of the organizational structure of these various institutions, which is based on a central administrating body, the university, associated with a network of regional centres distributed throughout the country together with a system of tutors, although Sri Lanka may be an exception in the case of the latter.

Another common approach relates to the use of audio- visual media. Most institutions, with the sole exception of University of Papua New Guinea, have been able to make use of radio and television in teaching, as well as being able to develop their own facilities for making video-tapes or video-programmes. The use of these media is a powerful tool for assisting in distance education, especially in those areas where face-to-face contact may be more difficult.

These institutions also share some problems. A practical component is essential for most science and technology courses, and yet all institutions have faced difficulties in this area. The system of using practical kits as originated by the Open University in the UK has been adopted by some institutions, but has been limited in its application owing to the large cost involved. Alternatively, a trend

has been to institute summer/residential schools in order to provide a concentrated period of practical tuition, but this has not appeared wholly satisfactory. Enrolment in science and technology programmes which are taught by distance education have tended to be lower compared with the number of students enrolled in other disciplines, such as arts and humanities. The reasons for this disparity are not entirely clear. Possibly the greater cost in terms of fees for these courses, which generally tend to be higher than say arts courses, may be a disincentive. Alternatively, these subjects may be perceived as being more difficult to study using the distance techniques by the perspective student who may choose an easier option.

Most institutions are dependent upon Government funding for the continuance of distance education. In many instances this can restrict the type and range of courses which may be offered. Most institutions charge fees from their students, but this only contributes a small proportion of useful revenue.

All the institutions report difficulties in preparation of materials. In particular, course writing is a persistent problem, and the expertise and experience with educational technology is not readily available in many cases.

Reports on Participating Institutions

For each institution, the nature and level of science technology and outreach programmes that are offered by distance education is noted, together with an indication of the number of students enrolled in these programmes. The organizational structure of each of the participating institutions is given together with an outline of the principal media utilized in the conduct of science and technology courses by distance education. Particular emphasis has been placed on the arrangements made to provide for the practical work that forms an integral component of most of these programmes. Institutions have also indicated where co-operative ventures with other

organizations have been initiated. The nature of any fees that are charged for these courses is also detailed for each institution.

Individual institutions have identified the major problems that have been encountered or are foreseen, with the development and implementation of courses in science and technology by distance education, and have provided a brief outline of possible future developments.

Darling Downs Institute of Advanced Education Australia

Darling Downs Institute of Advanced Education offers the following science and technology programmes by distance education.

Bachelor of Business (Information Systems).

Associate Diploma of Maths and Computing.

Graduate Diploma of Municipal Engineering.

Bachelor of Engineering (with majors in Civil, Electrical, Mechanical and Agricultural Engineering). The final year of these four-year courses must be undertaken oy full-time, on-campus study.

Associate Diploma of Civil Engineering.

Associate Diploma of Electrical and Electronic Engineering.

Associate Diploma of Mechanical Engineering.

Associate Diploma of Applied Science (Surveying)

Bridging course in surveying. This provides entry to the final level of the Bachelor of Applied Science (Surveying) offered by full-time, on-campus study at Queensland University of Technology, for holders of the Associate Diploma of Applied Science (Surveying).

In addition selected components of these higher education programmes are also used in extension or outreach study programmes.

There are approximately 1,600 students enrolled in the above programmes which represents about 30 per cent of the total number of students enrolled in all programmes by distance education offered by the Institute. There has been a steady growth in the numbers of students enrolled in these programmes and this is expected to continue.

Printed study materials are the major medium used for distance education in these programmes, but these are supplemented with audio and video tapes, and telephone tutorials. In addition many students have access to library and computing facilities at regional study centres. Residential schools of approximately five days per year are conducted for all courses. Extensive use is made of computer-managed learning as this proved to be very cost effective, allowing staff members to devote more time to the weaker students.

In Engineering programmes an "industrial tutor" scheme operates, whereby qualified professional engineers, usually at the students place of employment, are appointed as tutors. These industrial tutors assist the students with their work, providing tutorial assistance and supervising off-campus practical work.

Practical Work

All of the engineering and surveying courses involve extensive practical work. In addition to attendance at the residential school on the campus of the Darling Downs Institute, students are provided with home experiment kits and are required to have access to a microcomputer and peripheral hardware. Suitable computing facilities are located at several regional study centres, or often at the student's place of employment. Otherwise the students must purchase their own computer and associated hardware. In some

instances students are permitted to undertake practical work at their place of employment or at another educational establishment.

Organization

Darling Downs Institute of Advanced Education offers a comprehensive range of higher education programmes in engineering, education, applied science, business studies and arts. These programmes are offered by full-time, on-campus study and many are also available by distance education. Thus, unlike other institutions the preparation and production of study materials is undertaken in the majority of programmes by staff of the Institute. To facilitate the preparation and conduct of courses by distance education the Institute has established a Division of External and Continuing Education. This is responsible for the administration of external studies and maintenance of instructional standards; its functions include: assisting lecturers with the development of instructional materials, provision of evaluations of units by students, production and dispatch of instructional materials to students, co-ordination of all correspondence, including assignment work between students and teaching staff, and administration of regional study centres and the regional liaison officers (RLO) scheme.

The Division has over 70 academic and administrative support staff on campus. In addition, the Division administers an extensive off-campus support network for external students. Currently 18 geographical regions have been identified, each of which has at least one regional liaison officer and a study centre that serves as a local teaching resource centre and focus for group activities.

Fees

Students enrolled in science and technology programmes by distance education are required to contribute to the cost of their education. The amount of contribution is commensurate with the fees charged to students enrolled in other courses by other modes of

study. However the method of collection tends to discriminate against students enrolled in distance education programmes. The fees are also somewhat higher for engineering programmes primarily because of their longer duration.

Problems

The major difficulties that have been encountered with the implementation of programmes in science and technology by distance education are: the high cost of developing study materials for use in the course, the large amount of practical work demanded of students, and the computing and programming requirements of the course.

Future Developments

In the future it is likely that the number of institutions currently offering distance education courses will be drastically reduced to a group of about six major providers. Further the government has recommended that institutions with special academic expertise in a limited range of fields should offer that expertise externally only by co-operating with a principal provider, and that there should be greater collaboration between groups of institutions.

This process has already begun and an Australian Distance Education Consortium was formally established early in 1988. In general terms the Consortium aims to facilitate consultation and co-operation amongst all providers of external studies in higher education in Australia and facilitate the exchange of teaching materials amongst participating institutions.

It is anticipated that Darling Downs Institute will be designated as one of the major providers (Distance Education Centres) and consequently significant growth is expected in enrolment in science and engineering programmes by distance education. This growth may occur to a point where the demand will not be capable

of being satisfied by a single institution's working will in isolation. Other institutions will become involved and this will be facilitated by the existence of the Australian Distance Consortium. Co-operation between institutions will allow residential schools to be offered at different locations throughout Australia and some relaxation of the strict credit transfer arrangements between courses offered at different institutions is considered to be inevitable.

Central Radio and Television University (CRTVU) China

Science and Engineering Courses

Central Radio and Television University was first established in 1978. At present there are 60 science and technology courses offered by it. These courses are of four types and are normally of two to three years duration: foundation courses; basic specialized courses; specialized courses; and optional courses.

All these courses are offered at undergraduate level and include both Science and Engineering. Science courses offered are such as mathematics, biology, chemistry, and physics. Engineering courses are mechanical engineering, electrical engineering, chemical engineering, civil engineering, light industry engineering, agricultural engineering.

The engineering fields can offer some 60 different programmes which account for some 40 per cent of the total programmes offered by the University. Unfortunately details on enrolment are not available but it does appear that the proportion of students choosing these courses is falling.

There are other science and technology courses for continuing education and secondary vocational education available for short-term training.

Media

There are three systems of medium which are used for instruction in these courses :

Printed Teaching Materials: These are delivered by the New China Bookstores (nationwide book retailers).

Television Programmes: This is the major medium for science and technology courses. The courses are taught through a nationwide television: normal television channels (33 teaching hours per week) and specific satellite television channels (49 teaching hours per week). In addition, prerecorded video cassettes are distributed to provincial TV universities or to branch schools.

Radio Programmes: This is the main medium for social science courses. Programmes are delivered through local radio stations. Prerecorded audio cassettes are also sent to branch schools or to teaching and learning classes.

Organization

Distance education in China is organized at five levels: Central Radio and Television University (Beijing), provincial radio and television units, branch schools, work stations, and teaching and learning classes.

The branch schools of provincial and municipal radio and television units have all established laboratories related to science and technology courses. Also with the help of loans from the World Bank, 85 study centres in the whole country have been equipped. Each centre possesses laboratories, libraries and audio-visual classrooms. For those students living in remote areas, the branch schools regularly move around with experimental kits. The Central University sets unified requirements for every experimental course.

Future Developments

The Central University has acquired ten years of experience in distance education techniques, but in order to make science and technology courses more successful, it is proposed that there be certain future developments, such as the compilation of new types of printed teaching materials with the production of more imaginative audio-visual teaching materials, enriching the content of demonstration experiments by means of audio-visual teaching materials, and more effective use of radio and television resources.

Problems

The Central Radio and Television University system has encountered several problems. Firstly, there is need to change students learning habits. Students at high schools are used to a didactic approach. Distance education requires the student to be highly motivated and dependent upon his own efforts to acquire knowledge. Secondly, the system is strongly TV oriented. However the length of TV programmes is normally 50 minutes which for some students is too long to concentrate at the pace of the programme. It is suggested that the length of these programmes be reduced to 25 minutes. There is a lack of professional manpower and sophisticated TV recording hardware. Unfortunately this requires buying electronic goods from overseas, with foreign currency which is not readily available. Finally, the construction of university buildings needs to be completed as at present the university is not operating at its full capability.

Fees

Students do not normally have to pay tuition fees, these being subsidized by their work unit. Costs of registration, printed teaching materials and examinations are met by the students themselves.

Co-operation with Other Institutions

It is felt that in the future some attention must be given to new trends in science and technology programmes of distance education and to the use of the experience of other countries for reference in training teachers for writing science and technology materials and in the writing of scripts for the various media. Possibly financial aid should be from other countries or world bodies towards the purchase of advanced TV equipment.

Indira Gandhi National Open University
New Delhi, India

Indira Gandhi National Open University has been operating for three years. Science courses which are offered are preparatory and foundation courses. Preparatory course (General Mathematics) is offered as a non-credit course for B.A./B.Com students without the formal grade 10 + 2 qualification. Foundation course (Science and Technology) is for all students taking the Bachelor Degree Programme from September 1988.

In addition there are science courses being planned for September 1989 as part of the Bachelor Degree Programme in Science. These include: electives and application oriented courses in Chemistry, Physics, Life Science and Mathematics; science courses for non-science students.

The University also offers technology courses of various levels, namely: certificate level courses in Computer Science being developed with the help of the Committee for Co-operation in Science and Tech nology among Developing Countries; engineering courses for Diploma holders which can lead to a degree; awareness and outreach courses in technology.

The number of students enrolled in Science courses are as follows :

Students taking Preparatory courses in General Mathematics	10,800
Students taking Foundation course in Science and Technology	21,000
Projected intake of B.Sc.	5,000

As a percentage of the student population, it is difficult to calculate on a level basis, but if the B.Sc. programme is taken as the level, then the proportion of students enrolled in these programmes is ten per cent. It is also difficult to tell what directional trend in enrolment is occurring, since only a few programmes have been started, but for the "non grade 10+2 stream", the number of applicants has increased from 13,000 (session 1987/88) to 41,000 (session 1988/89).

Media

The mainstay of the delivery system is the printed material. This is supported by audio-visual material which is of a supplementary nature, corresponding to three per cent of student time. Face-to-face contact comprises ten per cent of student learning time.

Organization

The University has a small core staff in each discipline and strong divisions of distance education and communication. The course materials are prepared with the help of resource persons from other institutions. The University draws upon the best expertise available in the country. However the editing and formatting as well as audio-visual support is given by educational technologists and media experts of the University. For face-to-face contact, the Student Support Services, or Regional Services Division has 12 regional centres and around 110 study centres. Tutors and counsellors are drawn from conventional institutions.

As far as practical work is concerned, it is stipulated that about one-fourth of the study time in science electives with a practical component would be given to laboratory work. The credit proportion would be in consonance. The laboratory work would be mostly done during long summer/winter schools for a duration of eight weeks spreaded over two years at the second and the third (national) levels. This is less than in the conventional system. Application oriented courses may have a large lab component.

Proposed future developments include: the development of well equipped instruction research laboratories at the centre and instruction laboratories at some regional centres in a phased manner where orientation programmes for counsellors can be organized and where students can also work; and exploring the possibility of mobile laboratories for inaccessible and far flung areas.

Problems

One major problem that has been encountered is concerned with the organization of practical work, which at the degree level, becomes fairly sophisticated needing special infrastructure and facilities. To maintain the time devoted to practical work at a realistic level, laboratory curricula must be redesigned, removing repetitive work and introducing innovative experiments with higher learning output. Video could especially be used to demonstrate and expose students to experiences otherwise inaccessible. Scheduling may be another problem as both the laboratory work and end-of-term examinations have to be in June.

Fees

Policy decisions on these issues have yet to be taken. Science students would have to pay for their travel, board and lodging for the summer schools. Many of them would be utilizing their one months' leave for attending these summer schools. It would be unfair to charge higher fees for laboratory courses, except perhaps for

breakages. Similarly if the outreach courses are for the general public, the fee has to be kept low. It is not so much, here, as who wants to study these courses of mass education nature, as to whom we want to reach out to.

Co-operative Ventures

Indira Gandhi National Open University has the responsibility of co-ordinating and maintaining standards in higher education in the distance education institutions in the country. It works on a network principle, which utilizes infrastructural facilities and expertise from the conventional system. This is both in preparation of the learning material and in its delivery.

Universitas Terbuka
Indonesia

Universitas Terbuka, the Indonesian open learning university, which was officially opened in 4 September, 1984, offers distance education at the tertiary level. Its Mathematics and Science Faculty offers two study programmes at Bachelor of Science level: one in Applied Statistics and the other in Mathematics. Each study programme comprises 150 credits. One credit is the equivalence of an estimated 36 hours of study. Study programmes under the Mathematics and Science Faculty require no practical work.

Enrolment

The number of students by study programme during the first semester of 1988 up to May 1988 was as follows:

Applied Statistics	3,807
Mathematics	1,087

The total number (4894) in those two study programmes comprised about 67 per cent of the overall enrolment during that

period. In comparison the number of students enrolled in the study programme in Applied Statistics in 1984 (Mathematics was not offered at that time), was 9,000 which was about 15 per cent of the total enrolment at that time, showing a very significant decrease in 1988.

Medium of Instruction

The main delivery system is based on printed material. Tutorials are offered twice for each course prior to the semester examination. Students organize their own study groups, with the encouragement of the University giving them support whenever it is possible. Supporting materials in the form of audio-cassettes together with additional course materials are in the developing process. A more intensive tutorial system, with seven better structured tutorial sessions prior to the semester examinations, is under preparation and will be tried out in January and February 1989.

Future Developments

Two types of special programmes are being identified which seem to look promising. They include courses in science and technology with the involvement of practical work.

One type of special programme arises from the need of upgrading a large number of employees, like field consultants to farmers by the Ministry of Agriculture. Recently, Universitas Terbuka and the Ministry of Agriculture started to study the feasibility of offering by distance education a programme at the diploma level for the upgrading of field consultants to farmers, which amounted to more than 30,000. A preliminary study indicates that the need for facilities for laboratory work and field practice as well as manpower for tutors and instructors could be provided for. The main problem in conducting the programme might be the organizing of the laboratory work and field practices.

The second type of special programmes is related to the demand for high school graduates for relatively short training in certain skills which might increase the graduates' chances in getting a job. Preparations are under way for studying the feasibility of offering the so-called certificate programmes. These programmes will be relatively short programmes of three to five semesters. Programmes in biotechnology, food technology, computer applications and electronics will be considered. The programmes might be divided into two parts: the first part comprising the course work and the second part consisting of laboratory work and practical exercises. Successful completion of the course work can be made a prerequisite for taking the practical work. Students who have completed the course work successfully will receive a certificate, and after having completed the practical work successfully will receive a second certificate. Organizing the practical work will need wise and accurate planning.

Fees

In each semester the University has a registration period of four months, followed by a non-registration period of two months. A student can register for up to 12 credits by paying a registration fee of about US$25.00 or up to 18 credits by paying a registration fee of about US$37.50.

Printed study material costs about US$3.00 per credit, depending on the number of pages. Printed study material for a course of three credits will then cost about US$9.00. But buying printed study material is optional.

Fee structure for practical work has still to be designed. It is anticipated that laboratory work for science and engineering courses will be conducted in the existing conventional local universities. The University will have to conform to the existing standards in fee structure for practical work.

Future Co-operation

Universitas Terbuka in co-operation with the Ministry of Agriculture is designing and preparing a diploma programme by distance education for agricultural field consultants. In addition, in co-operation with the Ministry of Labour, studies will be carried out on the feasibility of offering certificate programmes.

All the other 44 state universities spreaded over the country, by instruction of the Minister of Education and Culture have to assist Universitas Terbuka. In fact, the Heads of its 32 regional centres are academic staff members of the local state universities.

Allama Iqbal Open University
Pakistan

Allama Iqbal Open University is a multi-media distance teaching institution with an annual course enrolment exceeding 120,000. It has 30 regional offices and 450 local study centres throughout Pakistan. Science and technology courses currently offered at various levels: Master's level; degree level; intermediate level; secondary school certificate level; non-credit courses; newspaper courses; teacher training courses; and basic level courses.

The enrolment in science and technology courses is approximately 30,000. In addition roughly 13,000 students are enrolled in outreach courses. This (43,000) is equivalent to approximately one third of the total enrolment.

Delivery System

Courses may be credited (secondary school certificate, intermediate, degree and Master's. Each counts eight credits, and one full credit entails approximately 180 hours of study, but practical work is additional), or non-credited. Admissions through any of the 30 regional offices are possible. Packages mailed from the University Headquarter contain study materials (except at master's level, for

which only study guides are sent), schedules, assignments, practical workbooks, tutorials and study centre appointments. Study consists of two semesters of 18 weeks per year at 450 study centres. Practical work is held in schools and college laboratories under local institutional staff during evenings and weekends. Practical work in technical courses is held in polytechnics institutes, and technical training centres. Teacher training institutions are also used for teacher education practical work. Continuous assessment comprises 40 per cent of the total with practical work contributing 25-30 per cent of the total. Final practical examination is arranged by an exchange of tutors. Tutorials are prearranged weekly or fortnightly.

For outreach courses flipcharts with pictorial messages, audio-cassettes and retention materials are used by a trained (one week) group leader who leads discussions, arranges resource persons, arranges simple practical skills courses.

Organization

Science, technology and outreach courses are developed by the Faculty of Basic and Applied Sciences, which can also be used by other faculties. There are six departments in the Faculty: Agricultural Science; Basic Science; Mathematics, Statistics and Computer Sciences; Technical and Vocational Education; Women's Education; and Science Education.

Media programmes are produced by the Institute of Educational Technology in collaboration with the academic staff of the teaching faculty. Outreach courses are delivered by the Bureau of University Extension Projects/Programmes.

Practical Work

This ranges from very simple activities at basic level to full-scale laboratory work up to 96 hours per course. Laboratory work is organized at existing schools, colleges, technical institutions, and

hospitals in the country during off-hours including weekends and holidays or in workshops of one to two weeks. Tutors are engaged from these institutions and briefed on course outline. Practical assessment is both continuous and final. Currently practical work is confined to all technical courses and to teacher training in science and in home economics.

Courses under Preparation

Preparation of the following courses is under way: postgraduate level in Dietetics; degree level in Food and Nutrition, Child Development, and Computer Science; intermediate level of certificates in Agriculture, Animal Husbandry, Science - Physics, Chemistry, Biology, Mathematics and Statistics, Health and Nutrition, Home Economics, and Community Health; diploma of Associate Engineering in Electronics and in Computer Technology with specialization in telecommunication, computer and audio-video equipment servicing; secondary school certificate level in Agriculture-based courses (as electives), Technical and Science; Teacher training in science leading to Bachelor of Education in Physics, Chemistry, Biology, and Mathematics; and outreach and continuing courses in Real life and rural-based courses of various kinds with particular emphasis on functional literacy and basic science.

Major Problems

Problems encountered by the University have been in the areas of: funding, facilities and equipment for programme activities in rural and remote areas, training of personnel for writing of technical materials and media production, training of university teachers, and incentives for science students and teachers.

Fee Structure

Less than one-third of the running costs is recovered in tuition fees and income from the sale of books. Tuition fees are low, but

comparable to the formal system. In the case of science and technical courses, travel costs and laboratory costs make the fee structure higher than that of the non-science courses.

Co-operative Ventures

The University actually collaborates with various government agencies and other developmental oriented organizations in the development and implementation of its programmes. It also maintains links with other universities in and outside of the country as well as with international organizations.

Department of Extension Studies
University of Papua New Guinea, Papua New Guinea

The Department of Extension Studies was founded in 1976 and most extension teaching is in Arts, Mathematics and Social Sciences. The only science courses offered are matriculation science courses: chemistry, physics and biology.

Each science course is taught over a period of 20 weeks, comprising approximately 12 hours private study time per week and with a weekly two-hour tutorial session at which students can air problems and discuss sets of study guide questions with their tutor. The course also involves assignments and practical work. Assignments are based on each of the six units which make up the total course. Practical work is partly the responsibility of the students themselves, in that they are individually sent a practical kit together with a booklet in order to carry out some fairly elementary practical work. Other practical work is held in two-day workshops at the University Centre. Evaluation is by means of assignments, practical work and examinations.

The approximate total annual enrolment is only 50 students in Matriculation Sciences. Obviously this is a very low proportion of the total University student population and is also a low proportion

of the students doing Matriculation Studies (approximately four per cent). This number of students appear to remain constant. The principal delivery system of these courses is by means of study guide booklets. Television or radio is not used.

Organization

Extension studies at UPNG is on three levels. First is the main University Department itself, which is the centre of operation and also a study centre in its own right. Second is the Provincial University Centres, which are at present located in eight provinces. Students in these provinces are attached to these institution. Ultimately it is aimed to have a centre in each of the 19 provinces in Papua New Guinea. Thirdly, there are some courses which can operate without the use of such centres e.g. English, Mathematics courses. These operate in all the provinces and are generally based at a particular high school or at a centre of its College of External Studies. The Department of Extension Studies at the University is in overall charge of these programmes.

Future Developments

Proposed future developments include: development of degree science programmes, introduction of distance teaching in medical and paramedical disciplines, possible involvement in technology courses, and investigation of the use of non-formal type education in certain areas (e.g. updates on medical topics)

Problems

Major problems included funding as relating to cost to students: the reliance on university funding, the reliance of external centres on provincial government funding; preparation, printing and distribution of materials; setting up of practical activities; availability of tutors; high dropout rate (although the rate of examination failure

is quite low); and co-operation with other faculties and departments in writing course materials.

Fees

Students have to pay enrolment fees. For science courses these are quite high, approximately K60 (Kina). Summer school sessions are very expensive with the cost of food and accommodation for six weeks, amounts to about K300 (7,500 rupees) which excludes the cost of transport, normally involving air travel.

Co-operative Ventures

The University has closer liaison with other university and institutions in Papua New Guinea and has greater involvement with University of South Pacific and also with other Pacific countries, for example Australia and New Zealand.

The Open University of Sri Lanka
Sri Lanka

The Open University was founded in 1980. It offers courses in both Natural Sciences (numbering to 91 courses) and Engineering Technology (numbering to 70 courses). These courses are offered at certificate, diploma and degree levels. Most programmes include a practical component and in some courses are made up entirely of practical work. The number of enrolled students in all science and technology programmes amounts to 9,790. This is approximately 50 per cent of the total student population, and this number is steadily increasing. The principal delivery system for these courses is a multi-media system where the main component is printed text.

Organization

The Open University of Sri Lanka has three faculties, namely: Natural Sciences, Engineering Technology and the Faculty of Humanities and Social Sciences.

Natural Sciences comprises the following disciplines : Mathematics, Life Sciences, Chemical and Physical Sciences.

Engineering Technology comprises : Civil Engineering, Mechanical Engineering, Textile Technology, Electrical and Electronic Engineering, Computer Science and Engineering.

Humanities and Social Sciences comprise : Legal Studies, Education, Languages, Management and Social Studies.

Practical Work

The extent of practical work involved in various programmes is as follows :

Natural Science: about 15-20 days per academic year. Laboratory classes are held at the headquarters complex and at regional centres.

Engineering Technology: about 15-20 days per academic year. Laboratory classes are held at the headquarters complex at Nawala. In addition extensive basic and specific workshop training courses are included in the programmes. Practical work includes basic training of 21 days and specific training (in industry) of two 15-day sessions.

Future Developments

Proposed future developments include specific certificate and postgraduate courses in science and technology.

Faculty of Natural Sciences: Certificate in Wild Life Management and Conservation, and Certificate in Aquaculture

Faculty of Engineering Technology: Bachelor of Technology in Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering; Certificate in Construction Management; and Postgraduate Diploma and Master of Technology in Construction Management, and in Agricultural Engineering

Problems

Problems which have been encountered include: the high cost of video production, the lack of experience in educational technology, and the scheduling of practical classes.

Fees

The course fees for the courses at different levels of study vary. Where there are practical components, the fee is considerably higher.

Co-operative Ventures

The establishment of course teams consisting of staff members from the different teaching institutions and the use of joint audio and video productions by these institutions would be desirable and could lead to the granting of credit for courses followed at other distance teaching institutions in the region.

Sukhothai Thammathirat Open University Thailand

Sukhothai Thammathirat Open University offers four-year degree, two and three-year degree, and one and two-year certificate programmes. These programmes are offered in ten academic areas, namely: Liberal Arts, Educational Studies, Management Science, Law, Health Science, Economics, Home Economics, Political Science, Agricultural Extension and Co-operative, and Communication Arts.

Some foundation courses in science are also offered such as Science and Society, Mathematics and Statistics, Nutrition, Basic Science for Home Economics, and Fundamentals of Bio-chemistry. All these courses are taught by means of programmed text with no laboratory work. There is, however, no degree programme in science and technology.

There is a plan to establish a school of science and technology in 1989/90. The main objectives in setting up this school is to meet future manpower needs in science and technology in Thailand; to upgrade the personnel in industries so that they can use and apply new technology efficiently; and to meet industry's growing needs for a better educated workforce.

The policy of the University is to avoid duplication of programmes which are already offered by the conventional universities except in cases where other universities are unable to meet the demand.

In order to reduce problems associated with organizing practical work, new courses have to be so selected that they do not need heavy shop work and can use computer laboratory as a tool to minimize shop work.

The following degree programmes will be offered: Industrial Technology in Manufacturing System Technology, and in Printing Technology; Commercial Technology in Business Information Technology; and Telecommunication Technology in Telecommunication System Technology. Programmes in Electronics Engineering, Computer Engineering and Power Engineering are also under consideration.

Medium of Instruction

The theory component will be taught by means of printed programmed text, in conjunction with the use of television and radio programmes. The practical component will be achieved by: home experiment kits; provision of laboratory equipment and tutors at designated educational service centres during the weekend in cooperation with local technical colleges; running practical workshops at the University's headquarter one intensive laboratory session per semester with a duration of three to four days (12 hours per day per

course); using "home computing" by providing students with software and direction in some particular courses.

The University has already gained experience in running such intensive practical workshops in various subjects and has found that it is possible to bring the students to the centre and give the "hands-on" experience in a period of three to four days.

Problems

One of the problems that might be encountered in establishing the school of science and technology could be the difficulty in procuring appropriate staff to write programmed texts in science and technology. The other problem is that the programmes and curricula must be acceptable to the professional agency and the courses must be compatible in standard with those run by conventional universities. This will require a great deal of collaboration and co-operation from other institutions in order to allow their staff to act as authors and tutors. There may as well be problems with regard to getting required funding, space and manpower in order to establish new laboratories.

Fees

It is quite clear that students in the school of science and technology pay higher tuition fees than students in social science programmes. In addition to tuition and fees, students will also have to bear extra cost for practical work, travel expenses, accommodation and food during their stay for the workshops. Again, this would probably be higher for students in science and technology programmes.

The University has negotiated with industries to allow their employees to study at the University and to provide partial or even full support for the cost of their tuition fees.

Co-operative Ventures

The curriculum committees often include important members of professional associations or leaders from industries which help to maintain close contact with these institutions and reflect their needs. The University is planning to collaborate with other technical universities or institutions in order to provide assistance in the preparation of experimental kits at a reasonable price and in using their existing facilities and staff.

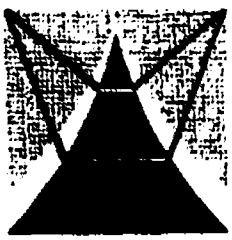
Appendix B

LIST OF PARTICIPANTS

China **(People's Republic of)**	Mr. Cai Shu Central Radio & TV University 83, Fuxing Road Beijing
India	Prof. (Mrs.) Shakti R. Ahmed Director, School of Sciences Indira Gandhi National Open University A-39, Kailash Colony New Delhi 110048
Indonesia	Prof. Suwardi Dean, Fac. of Mathematics and Science Universitas Terbuka Complex U.I. Ciputat House No.86 Jl. Ciputat Raya, Jakarta
Pakistan	Dr. (Mrs.) Nadira Khan Chairperson Department of Science Education Allama Iqbal Open University Sector H-8, Islamabad

Papua New Guinea	Mr. Geryk Raymond John Department of Extension Studies Faculty of Education University of Papua New Guinea P. O. Box 320, UNIVERSITY
Sri Lanka	Prof. (Mrs.) N.B. Ratnasiri Dean, Faculty of Natural Science Open University of Sri Lanka P. O. Box 21 Nawala, Nugegoda
	Prof. H. Sriyananda Professor of Electrical and Electronic Engineering Open University of Sri Lanka
Thailand	Associate Prof. Vanchai Sirichana Vice-Rector for Operations Sukhothai Thammathirat Open University Bangpood, Pakkred Nonthaburi 11120
Resource Person	Dr. M.J. Morgan Associate Dean (Academic Services) School of Engineering Darling Downs Institute of Advanced Education Post Office Darling Heights Toowoomba, QLD 4350 Australia

UNESCO PROAP	Dr. Muhammad Selim Specialist in Higher Education UNESCO PROAP, Bangkok Thailand
OBSERVERS	
OUSL, Sri Lanka	Prof. N.R. Arthenayake Professor of Mechanical Engineering
	Prof. J.N.O. Fernando Professor of Chemistry
	Prof. E.M. Jayasinghe Professor of Physics
	Prof. (Mrs.) P.J. Paulraj Professor of Botany
	Dr. G. Abeysuriya Senior Lecturer in Civil Engineering
	Mr. B.A. Dissanayake Senior Lecturer in Textile Technology



Regional Co-operative Programme
in Higher Education for Development
in Asia and the Pacific